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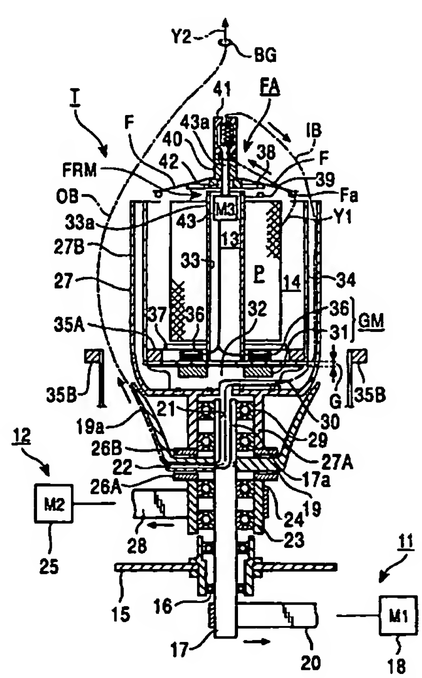
(54) Flyer device and flyer drive method

(57) The present invention directly couples a rotative-drive source to a flyer so as to positively drive the flyer in synchronism with a speed at which a yarn is unwound. This construction prevents variations in tension regardless of an unwinding position, that is, whether the yarn is unwound from an upper or a lower side of a package and regardless of the winding diameter of the package, thereby restraining yarn breakage. The present invention provides a flyer device comprising a flyer for use in unwinding a yarn 1 from a package P or twisting the yarn after unwinding it from the package, wherein the device has flyer rotative-drive means FRM rotating in an interlocking manner as the yarn is unwound, for positively rotatively driving the flyer. It also provides a flyer device wherein flyer rotative-drive means comprises a flyer rotative-drive source 43 and a one-way clutch 42 combined with a rotating shaft of the flyer rotative-drive source.

FIG. 1A



Description

Field of the invention

[0001] The present invention relates to a flyer device for use in unwinding a yarn from a package or twisting a yarn after unwinding it from a package, and in particular, to a flyer device that can restrain variations in tension regardless of an unwinding position, that is, whether the yarn in unwound from an upper or a lower end side of the package and regardless of the winding diameter of the package and that can restrain balloon variations.

Background of the Invention

[0002] As is well known, a flyer device constructed to rotate as a yarn is unwound from a package and to guide the unwound yarn is conventionally used for simply unwinding a yarn from a package, or twisting the yarn after unwinding it from the package as in a multiple twister. This conventional flyer is constructed so as to rotate based on the tension of the yarn unwound from the package; that is, it is based on a negative drive type (free rotation type).

[0003] This conventional flyer based on the negative drive type has a low unwinding tension if a position of a package from which a yarn is unwound (an unwinding point) is shifted to an upper side of the package, and has a higher tension if the yarn unwinding position is shifted to a lower side because the yarn is unwound while rubbing a surface of the package. Further, while the winding diameter of the package is large, the unwinding tension is low, and the unwinding tension increases with decreasing winding diameter of the package. Thus, variations in tension during the yarn unwinding period has been pointed out as a major problem.

[0004] When the tension varies during yarn unwinding as described above, balloons are widened if the tension decreases. For example, in a quadruple twister, an inner balloon and an outer balloon may come in contact with each other. This has often caused yarn breakage.

[0005] Further, when a yarn is unwound from a package, unwinding is carried out while the yarn is being rubbed against an outer layer of the package. As a result, variations in tension during yarn unwinding have often generated fluffs.

[0006] Thus, the present invention attempts to solve the above problems conventionally pointed out. It is an object of the present invention to provide a flyer device wherein a rotative-drive source is directly coupled to a flyer to positively drive the flyer in synchronism with a yarn unwinding speed in order to restrain variations in tension and balloon shape irrespective of an unwinding position, that is, whether the yarn is unwound from an upper or a lower end side of the package and irrespective of the winding diameter of the package, thereby eliminating the causes of yarn breakage.

Summary of the Invention

[0007] To attain the above object, the present invention specifically constructs a flyer device comprising a flyer for use in unwinding a yarn from a package or twisting a yarn after unwinding it from a package, the device having the flyer rotative-drive means rotating in an interlocking manner as the yarn is unwound, for positively rotatively driving the flyer.

[0008] Further, the present invention constructs a flyer device wherein the flyer rotative-drive means comprises the flyer rotative-drive source and a one-way clutch combined with a rotating shaft of the flyer rotative-drive shaft, and wherein the flyer is connected via the rotating shaft of the flyer rotative-drive source and the one-way clutch.

[0009] Further, the present invention constructs a flyer device comprising a flyer for use in a multiple twister for twisting a yarn after unwinding it from a package, wherein a power supply for the flyer rotative-drive source comprises generation means for generating power in response to rotative driving of the twister.

[0010] Further, the present invention constructs a generation system for a motor-driven flyer operative in a multiple twister for twisting a yarn after unwinding it frown a package using a flyer, wherein the system includes a flyer drive motor for driving the flyer, and wherein a spindle rotative-drive system and a stationary system in the multiple twister each have generation means for converting relative rotational motion into electric energy for output, so that an electric output from the generation means is used to rotatively drive the flyer drive motor.

[0011] Further, the present invention constructs a generation system for a motor-driven flyer wherein the generation means comprises a permanent magnet comprising S-pole elements and N-pole elements alternately and concentrically arranged on a rotating disc section in the spindle rotative-drive system of the multiple twister, and also comprises magnetic field members provided in the stationary system of the multiple twister so as to be opposed to the permanent magnets via a field gap.

[0012] Further, the present invention constructs a generation system for a motor-driven flyer wherein a control substrate is provided in the stationary system of the multiple twister for driving and controlling the flyer drive motor.

[0013] Further, the present invention constructs a generation system for a motor-driven flyer wherein the system has rotation speed measuring means for measuring the rotation speed of the flyer driven by the flyer drive motor to com-

pare a measured value with a set rotation speed while automatically setting a new rotation speed depending on the ratio of the measured value to the set value.

[0014] In order to achieve the above object, the present invention provides a flyer drive method operative in a multiple twister for twisting a yarn after unwinding it from a package using a flyer, wherein the method comprises a flyer drive motor for driving the flyer and rotation speed measuring means for measuring the rotation speed of the flyer drive motor, and wherein the rotation speed of the flyer is measured for a predetermined period of time at the beginning of operation, so that a new value is set for the drive motor based on the measured flyer rotation speed.

[0015] Further, the present invention configures a flyer drive method wherein the rotation speed of the flyer is measured for a predetermined period of time at the beginning of operation, so that a rotation speed corresponding to a predetermined percentage of the measured flyer rotation speed is set as an initial set value of the motor drive speed.

[0016] In addition, the present invention configures a flyer drive method wherein the initial set value of the motor drive speed is set smaller than the value of the measured rotation speed.

[0017] Furthermore, the present invention configures a flyer drive method wherein a rotation speed measured by the rotation speed measuring means during operation is compared with the set rotation speed, while a new rotation speed is automatically set based on the ratio of the measured value to the set value.

Brief Description of the Drawing

[0018]

Figure 1 shows a specific example of a construction in which the flyer device according to the present invention is applied to a quadruple twister. Figure 1A is a schematic side sectional view showing the entire specific example of a construction in which the flyer device according to the present invention is applied to a quadruple twister. Figure 1B is a schematic top view showing a specific example of a pulse-measuring counter. Figure 1C is a schematic top view showing a specific example of a permanent-magnets-arranged disc in generation means.

Figure 2 is a schematic drawing for describing an example of a yarn unwinding aspect of a multiple twister. Figure 2A is a schematic side view showing an example in which the present invention is applied to a double twister and showing a state in which a yarn unwinding position is located on an upper side of a package. Figure 2B is a schematic side view also showing the example in which the present invention is applied to a double twister and showing a state in which the yarn unwinding position is located on an lower side of the package.

Figure 3 is a schematic drawing for describing an example of a yarn unwinding aspect of a multiple twister. Figure 3A is a schematic side view showing an example in which the present invention is applied to a quadruple twister and showing a state in which the yarn unwinding position is located on the upper side of the package. Figure 3B is a schematic side view also showing the example in which the present invention is applied to a quadruple twister and showing a state in which the yarn unwinding position is located on the lower side of the package.

Figure 4 is a tension waveform diagram showing how the tension varies when a yarn is unwound from a package, wherein the horizontal axis represents the time, while the vertical axis represents the tension. Figure 4A is a tension waveform diagram showing a case where the package has a large diameter (about Ø 135mm to Ø133mm) and where a flyer based on the conventional negative drive method is used. Figure 4B is a tension waveform diagram showing a case where the package has a large diameter (about Ø135mm to Ø133mm) and where a flyer drive method based on a positive drive method according to the present invention is applied.

Figure 5 is a tension waveform diagram showing how the tension varies when a yarn is unwound from a package, wherein the horizontal axis represents the time, while the vertical axis represents the tension. Figure 5A is a tension waveform diagram showing a case where the package has a small diameter (about Ø 48mm to Ø46mm) and where a flyer based on the conventional negative drive method is used. Figure 5B is a tension waveform diagram showing a case where the package has a small diameter (about Ø48mm to Ø46mm) and where a flyer drive method based on a positive drive method according to the present invention is applied.

Figure 6 is a flow chart of the flyer drive method according to a present invention.

Figure 7 is a schematic drawing for describing a basic construction of a multiple twister. Specifically, this is a schematic perspective view showing a single spindle section of a double twister.

Detailed Description of the Preferred Embodiments

[0019] A flyer device and method according to the present invention will be described below in detail based on a specific embodiment, which is shown in the drawings.

[0020] First, a specific construction of a single-spindle twisting unit TU in a double twister will be described with reference to Figure 7.

[0021] The single-spindle twisting unit TU comprises a spindle device 61 and a winding device 62. The spindle

device 61 has a stationary disc (not shown in the drawing) and a rotating disc 64 fixed to a spindle shaft 63. A yarn Y1 is unwound from a supplying package SP placed on the stationary disc kept stationary by a magnetic attraction, and then enters a tension device 65, where it is subjected to a predetermined tension. Subsequently, the yarn Y1 is ballooned by means of a fast rotation of a rotating disc 64 located below the stationary disc, and then reaches a balloon guide 67 located above the tension device 65. The yarn is twisted once between the tension device 65 and the rotating disc 64, and twisted again between the rotating disc 64 and the balloon guide 67. Thus, the yarn is twisted twice in total, so that a twisted yarn Y2 subjected to double twisting processing is finally supplied. According to the embodiment shown in Figure 7, each spindle constitutes a individual-spindle-driving type twisting unit including a spindle drive source 68.

[0022] On the other hand, the winding device 62 winds up the twisted yarn Y2 toward a winding package 69. The twisted yarn Y2 reaches a traverse guide 73 via guide rollers 70, 71 and a feed roller 72. The twisted yarn Y2 is traversed by the traverse guide 73, and then wound around the winding package 69 supported by a cradle arm 74 and in rolling contact with a winding drum 75.

[0023] The number of twists applied per meter in a double twister of this kind is expressed by the following equation:

$$\text{Number of twists} = [\text{rotation speed of the rotating disc (rpm)} \times 2] / \text{yarn speed (m/min.)}$$

[0024] Where the yarn speed depends on the winding speed of the winding device and where the rotation speed of the rotating disc depends on the rotation speed of a spindle shaft of the spindle device.

[0025] The above single-spindle twisting unit is of a filament yarn or a spun yarn supplying package construction, and the flyer drive method is applicable to both constructions.

[0026] The flyer drive method according to the present invention will be explained in detail with reference to Figures 1 to 6. Figure 1 shows a specific example of a construction in which the flyer drive method according to the present invention is applied to a quadruple twister T. In the embodiment shown in Figure 1, the quadruple twister T including a flyer device FA comprises a first rotative-drive system section 11, a second rotative-drive system section 12, a third rotative-drive system section 13, and a stationary-system section 14.

[0027] The first rotative-drive system section 11 of the quadruple twister T comprises a spindle 17 installed in a spindle rail 15 via a bearing mechanism 16, a first rotative-drive source 18 for rotatively driving the spindle 17, and an outer pot structure 19 attached to the spindle 17. Specifically, the first rotative-drive source 18 in the first rotative-drive system section 11 is a motor M1 constructed to rotate the spindle 17 at a rotation speed between about 8,000 ~ 10,000 rpm using a motor belt 20.

[0028] The spindle 17 has the outer pot structure 19 fixedly attached thereto on its upper-end side 17a, and the outer pot structure 19 is constructed to rotate at a rotation speed between about 8,000 ~ 10,000 rpm by means of the motor M1. The spindle 17 has an unwound yarn passage 21 formed on the upper-end side 17a and extending in an axial direction, and the outer pot structure 19 has an unwound yarn passage 22 formed therein and extending in a radial direction so as to penetrate through the outer pot structure 19 to its exterior. An outer surface 19a of the outer pot structure 19 is shaped like a trumpet widening in an upward direction.

[0029] On the other hand, the second rotative-drive system section 12 of the quadruple twister T comprises a rotating pulley 24 attached to the spindle 17 via a bearing mechanism 23, a second rotative-drive source 25 for rotatively driving the rotating pulley 24, and an inner pot structure 27 magnetically connected to the rotating pulley 24 via a magnet coupling mechanisms 26A, 26B. Specifically, the second rotative-drive section 25 in the second rotative-drive system section 12 is a motor M2 constructed to rotate the inner pot structure 27 via the rotating pulley 24 and the magnet coupling mechanisms 26A, 26B at a rotation speed between about 3,000 ~ 10,000 rpm. The inner pot structure 27 is designed to rotate in a rotational direction opposite to that of the outer pot structure 19.

[0030] The inner pot structure 27 has a base 27A supported on the spindle 17 via a bearing mechanism 29, and has an unwound yarn passage 30 located on its base 27A side and extending in the radial direction so as to penetrate through the inner pot structure 27 to its exterior. The inner pot structure 27 further has a permanent-magnets-arranged disc 32 located on its base 27A side and fixedly attached thereto for placement of permanent magnets 31, which will be described below. Figure 1C shows an example of a arrangement aspect of the permanent magnets 31 arranged on the permanent-magnets-arranged disc 32. The permanent magnets 31 comprise S-pole elements 31S and N-pole elements 31N alternately arranged concentrically with the rotating disc section of the spindle rotative-drive system of the quadruple twister T.

[0031] The inner pot structure 27 includes a cylindrical pot section 27B extending upward from the base 27A and opened on an upper-end side thereof, so as to restrict the locus of an inner balloon IB, which will be described below, by means of an inner peripheral surface of the cylindrical pot section 27B.

[0032] On the other hand, the stationary-system section 14 of the quadruple twister T comprises a package support section 33 for supporting a package P on the axis of the spindle 17, and a package cover section 34 for forming covers in the outer periphery of the package P at a desired interval, with the package supported by the package support sec-

tion 33.

[0033] The stationary-system section 14 is kept stationary by stationary magnet means 35A, 35B during a rotation period of the first rotative-drive system section 11 and the second rotative-drive system section 12.

[0034] Furthermore, the stationary-system section 14 comprises magnetic field members 36 comprising magnetic field coils opposed via a field gap G to the permanent magnets 31 arranged on the permanent-magnets-arranged disc 32 in the second rotative-drive system section 12. The permanent magnets 31 and the magnetic field members 36 constitute generation means GM. In addition, the stationary-system section 14 has a control substrate 37 combined therewith for driving and controlling the flyer drive motor.

[0035] The stationary-system section 14 comprises a detection section 39 such as an optical sensor which is attached to the package support section 33 at its upper-end side 33a to respond to a pulse-measuring counter 38, which will be described below. In the present invention, the pulse-measuring counter 38 and the detection means 39 constitute rotation speed-measuring means RSM.

[0036] According to the preferred embodiment of the present invention, the pulse-measuring counter 38 is formed of a disc member fixedly attached to a flyer support 40 and divided into pieces at appropriate angular intervals by means of a plurality of radial lines, as shown in Figure 1B. The pulse-measuring counter 38 is designed to provide, for example, 30 or 6 counts per round.

[0037] On the other hand, the third rotative-drive system section 13 of the quadruple twister T constitutes an essential part of the present invention. The third rotative-drive system section 13 comprises a flyer support 40 for supporting a flyer F in such a manner that the rotational axis of the flyer aligns with the axis of the spindle 17, a tenser 41 attached to the flyer support 40, and flyer rotative-drive means FRM for rotating the flyer F using a one-way clutch mechanism 42 interposed between the flyer rotative-drive means FRM and the flyer support 40.

[0038] According to the present invention, the flyer rotative-drive means FRM rotates in an interlocking manner as the yarn is unwound and positively rotatively drives the flyer in synchronism with a yarn unwinding speed. That is, the flyer rotative-drive means FRM comprises a flyer rotative-drive source 43 comprising a motor M3, and the one-way clutch 42 combined with a rotating shaft 43a of the flyer rotative-drive source. The flyer rotative-drive source FRM has the flyer F connected thereto via the rotating shaft 43a of the flyer rotative-drive source 43 and the one-way clutch 42.

[0039] Incorporation of the flyer rotative-drive means FRM by connecting the flyer F and the flyer rotative-drive source 43 comprising the motor M3 together via the one-way clutch mechanism 42 (the flyer rotates freely when its rotation speed is higher than that of the flyer rotative-drive source 43) is based on the fact that the flyer speed and the unwinding tension are low when the yarn is unwound from an upper side position P1 of the package P as shown in Figures 2A and 3A. By feeding back this speed to the motor M3, the flyer is rotated faster than the flyer rotative-drive source 43 to eliminate the unwinding tension when the yarn is unwound from a position of the package P other than its upper side positions, thereby keeping the unwinding tension almost constant regardless of the package diameter and of whether the yarn is unwound from the upper side position P1 of the package P or a lower-side position P2 thereof.

[0040] In the above specific example of a construction, the third rotative-drive system section 13 has the pulse-measuring counter 38 such as one shown in Figures 1A and 1B, and the pulse-measuring counter 38 and the detection means 39 provided in the stationary-system section 14 serve to subject the motor M3 in the flyer rotative-drive means FRM to feedback control.

[0041] Further, according to the present invention, the flyer device is constructed to be rotatively driven at a speed at which the yarn is unwound from the upper side of the package P, that is, a maximum unwinding speed. In addition, according to the present invention, the power supply for the flyer rotative-drive source can be constructed using a battery or a solar battery instead of the generation means GM.

[0042] In the quadruple twister T comprising the flyer drive device FA configured as described above, the yarn Y1 unwound from the package P passes through a yarn guide section Fa of the flyer F, the tenser 41 provided in the third rotative-drive system section 13, a cylindrical void between the package cover 34 and the inner pot structure 27, the unwound yarn passage 30 formed in the inner pot structure 27 of the second rotative-drive system section 12, the unwound yarn passage 21 formed in the spindle 17 of the first rotative-drive system section 11, the unwound yarn passage 22 formed in the outer pot structure 19, and a balloon guide BG, before it is wound by a winding device.

[0043] In this case, the yarn Y1 unwound from the package P forms a locus of the inner balloon IB between the tenser 41 and the inner pot structure 27, while forming a locus of an outer balloon OB between the outer pot structure 19 and the balloon guide BG. While passing through the third rotative-drive system section 13 including the flyer device FA, the second rotative-drive system section 12 including the inner pot structure 27, the first rotative-drive system section 11 including the outer pot structure 19, and the balloon guide BG, the yarn Y1 unwound from the package P is twisted four times, so that the twisted yarn Y2 is finally supplied.

[0044] In conjunction with the flyer drive method according to the present invention, specific contents of a method for controlling the rotation speed of the flyer will be described.

[0045] First, in a multiple twister comprising the positively driven flyer, when a start switch is turned on to operate the twister, the flyer drive motor using self-generation means as a drive power supply remains inoperative for about five

seconds despite the activation of the device, thereby providing a time zone in which the flyer rotates freely. During this start of operation, the yarn unwinding speed is determined. For example, a pulse-measuring counter is provided for counting six pulses per round using an optical sensor so that the frequency can be determined based on a count obtained in five seconds. Five seconds after the start of operation, the flyer drive motor is driven at a speed corresponding to 80% of the frequency determined. In this manner, over-unwinding caused by an extremely high rotation speed can be prevented by reducing the rotation speed of the flyer drive motor.

[0046] Subsequently, the amount of time required for one pulse (1/6 rotation) is measured a predetermined number of times, and the difference between a maximum amount of time obtained and a minimum amount of time obtained is determined. If, for example, the difference is 50 msec. or more, the rotation speed of the flyer drive motor is determined to be too low, and the frequency is then slightly increased. In addition, if, for example, the difference is determined to be less than 50 msec. a predetermined number of times, the frequency is slightly reduced in order to prevent the flyer from rotating one round faster than desired due to an extremely high rotation speed of the flyer drive motor.

[0047] In this manner, the rotation speed of the flyer drive motor is measured for a predetermined amount of time during the start of operation, and a predetermined percentage (about 80%) of the measured rotation speed is controllably set as an initial set value of the motor drive speed. In addition, a rotation speed measured by the rotation speed-measuring means during operation is compared with the set rotation speed, while a new rotation speed is automatically set depending on the ratio of the measured value to the set value.

[0048] Then, with reference to Figures 4A and 4B and 5A and 5B, the flyer drive method according to the present invention will be compared with a conventional freely-rotating flyer drive method without a rotative-drive source, so that variations in unwinding tension are comparatively examined.

[0049] Figure 4 is a graph indicating the time on the horizontal axis while indicating the tension on the vertical axis (this applies to the following description), in other words, this figure is a tension waveform diagram showing variations in unwinding tension in a case where the package P has a large diameter (about Ø135mm to Ø133mm). Figure 4A is a graph showing variations in unwinding tension in a conventional freely-rotating flyer device without a rotative-drive source, and Figure 4B is a graph showing variations in unwinding tension in a positively-rotating flyer device with a rotative-drive source according to the present invention. On the other hand, Figure 5 is a tension waveform diagram showing variations in unwinding tension in a case where the package P has a small diameter (about Ø48mm to Ø46mm). Figure 5A is a graph showing variations in unwinding tension in the conventional freely-rotating flyer device without a rotative-drive source, and Figure 5B is a graph showing variations in unwinding tension in the positively-rotating flyer device with a rotative-drive source according to the present invention.

[0050] As apparent from Figures 4A, 4B, 5A and 5B, the positively-rotating flyer device with a rotative-drive source according to the present invention shown in Figures 4B and 5B maintains an almost constant unwinding tension during the unwinding period (the period of a reciprocating run between the upper side position P1 and lower side position P2 of the package) regardless of the winding diameter of the package P, thereby providing substantially improved effects compared to conventional freely-rotating flyer device without a rotative-drive source shown in the graph in Figures 4A and 5A, which is subjected to large variations in unwinding tension during the unwinding period.

[0051] In summary as shown in Figure 6, the flyer drive method according to the present invention is configured as follows: in an operation start stage of a multiple twister, the flyer makes negative rotations, and the rotation speed of the flyer is measured using the rotation speed-measuring means. Then, the initial rotation speed is set equal to about 80% of the measured value, and the measured value is compared with the set value. When no difference is found for a fixed period of time (the measured value does not exceed the set value), an instruction for deceleration is issued; when a difference occurs (the measured value exceeds the set value), an instruction for acceleration is issued.

[0052] According to the present flyer device constructed as described above, the flyer can be driven at a rotation speed optimum for unwinding of the yarn. In addition, the flyer rotates in a fashion following the yarn despite its rapid rotation, thereby enabling the yarn to be unwound without applying an excessive tension to the yarn. Thus, possible yarn breakage can be prevented.

[0053] Further, according to the flyer device according to the present invention, the power supply for the motor M3 in the third rotative-drive system section for positively rotatively driving the flyer is constructed so as to supply electricity using the generation means based on rotative driving by the twister, thereby reducing operation costs. Consequently, the present flyer device is very effective.

[0054] In addition, in unwinding the yarn around the lower part of the package, the flyer device according to the present invention performs this operation in a fashion tearing off the yarn from the package, thereby preventing possible fluffing and allowing the formation of stable balloons, compared to the conventional unwinding method of unwinding the yarn while rewinding it around the surface of the package. In this point, the present flyer device is also very effective. In addition, in a quadruple twister forming the inner balloon IB and the outer balloon OB the present flyer device can preclude a possible contact between the inner balloon IB and the outer balloon OB caused by variations in tension during unwinding, thereby preventing possible yarn breakage. In this point, the present invention is also very effective.

[0055] According to the present generation system for a motor-driven flyer constructed as described above, the

rotation of the rotating disc of the multiple twister can be used for generation to obtain a drive force that requires no external power supply. Thus, the present generation system is very effective.

[0056] Further, in the generation system for a motor-driven flyer according to the present invention, each twisting section can be independently controlled to enable stable unwinding and twisting. In this point, the present generation system is also very effective.

[0057] In addition, in the generation system for a motor-driven flyer according to the present invention, the rotation speed of the flyer can be reliably controlled so as to increase with decreasing package diameter associated with unwinding of the yarn from the package. In this point, the present generation system is also very effective.

[0058] Further, in the generation system for a motor-driven flyer according to the present invention, the flyer can be driven at a rotation speed optimum for unwinding of the yarn, and the flyer rotates in a fashion following the yarn despite its rapid rotation, thereby enabling the yarn to be unwound without applying an excessive tension to the yarn. As a result, possible yarn breakage can be prevented.

[0059] In addition, in the generation system for a motor-driven flyer according to the present invention in unwinding the yarn around the lower part of the package, the flyer device performs this operation in a fashion tearing off the yarn from the package, thereby preventing possible fluffing and allowing the formation of stable balloons, compared to the conventional unwinding method of unwinding the yarn while rewinding it around the surface of another package. In this point, the present flyer device is also very effective. In addition, in a quadruple twister forming the inner balloon IB and the outer balloon OB, the present flyer device can preclude a possible contact between the inner balloon IB and the outer balloon OB caused by variations in tension during unwinding, thereby preventing possible yarn breakage. In this point, the present invention is also very effective.

[0060] The flyer drive method of the present invention configured as described above is effective in that an optimum rotation speed can be set depending on the yarn unwinding conditions for each spindle of the multiple twister, thereby enabling the flyer to be driven at a rotation speed optimum for unwinding of the yarn. It is also very effective in that the flyer rotates in a fashion following the yarn despite its rapid rotation, thereby enabling the yarn to be unwound without applying an excessive tension to the yarn to prevent possible yarn breakage.

[0061] Further, according to the flyer drive method of the present invention, the flyer can be driven by the motor immediately after the start of operation, and even if the flyer is rotated at an extremely high speed immediately after the start of operation, the drive rotation speed is set equal to 80% of this high rotation speed. Consequently, the flyer can be precluded from rotating one round faster than desired due to an extremely high rotation speed of the flyer drive motor, thereby preventing damage to the yarn. In this point, the present flyer drive method is very effective.

[0062] In addition, according to the flyer drive method of the present invention, the rotation speed of the flyer can be reliably controlled so as to increase with decreasing winding diameter associated with unwinding of the yarn from the package. In this point, the present flyer drive method is also very effective.

Claims

1. A flyer device comprising a flyer for use in unwinding a yarn from a package or twisting a yarn after unwinding it from a package, characterized by having flyer rotative-drive means for positively rotatively driving said flyer.

2. A flyer device as in Claim 1, characterized in that said flyer rotative-drive means comprises a flyer rotative-drive source and a one-way clutch combined with a rotating shaft of said flyer rotative-drive source, and in that said flyer is connected via the rotating shaft of said flyer rotative-drive source and said one-way clutch.

3. A flyer device as in Claim 2, comprising a flyer for use in a multiple twister for twisting a yarn after unwinding it from a package, characterized in that a power supply for said flyer rotative-drive source comprises generation means for generating power in response to rotative driving of said twister.

4. In a multiple twister for twisting a yarn after unwinding it from a package using a flyer, a flyer device as in Claim 3, characterized in that a spindle rotative-drive system and a stationary system in said multiple twister each have generation means for converting relative rotational motion into electric energy for output, so that an electric output from said generation means is used to rotatively drive said flyer drive motor.

5. A flyer device as in Claim 4, characterized in that said generation means comprises a permanent magnet comprising S-pole elements and N-pole elements alternately and concentrically arranged on a rotating disc section in the spindle rotative-drive system of said multiple twister, and also comprises magnetic field members provided in the stationary system of said multiple twister so as to be opposed to said permanent magnets via a field gap.

6. A flyer device as in Claim 4, characterized in that a control substrate is provided in the stationary system of said

multiple twister for driving and controlling said flyer drive motor.

7. A flyer device as in Claim 4, characterized in that the device has rotation speed measuring means for measuring the rotation speed of the flyer driven by said flyer drive motor to compare a measured value with a set rotation speed while automatically setting a new rotation speed depending on the ratio of the measured value to the set value.

8. In a multiple twister for twisting a yarn after unwinding it from a package using a flyer, a flyer drive method characterized in that the method comprises a flyer drive motor for driving said flyer and rotation speed measuring means for measuring the rotation speed of said flyer drive motor, and in that the rotation speed of said flyer is measured for a predetermined period of time at the beginning of operation, so that a new value is set for said drive motor based on the measured flyer rotation speed.

9. A flyer drive method as in Claim 8, characterized in that the rotation speed of said flyer is measured for a predetermined period of time at the beginning of operation, so that a rotation speed corresponding to a predetermined percentage of the measured flyer rotation speed is set as an initial set value of the motor drive speed.

10. A flyer drive method as in Claim 9, characterized in that the initial set value of said motor drive speed is set smaller than the value of the measured rotation speed.

11. A flyer drive method as in Claim 8, characterized in that a rotation speed measured by said rotation speed measuring means during operation is compared with the set rotation speed, while a new rotation speed is automatically set based on the ratio of the measured value to the set value.

FIG. 1A

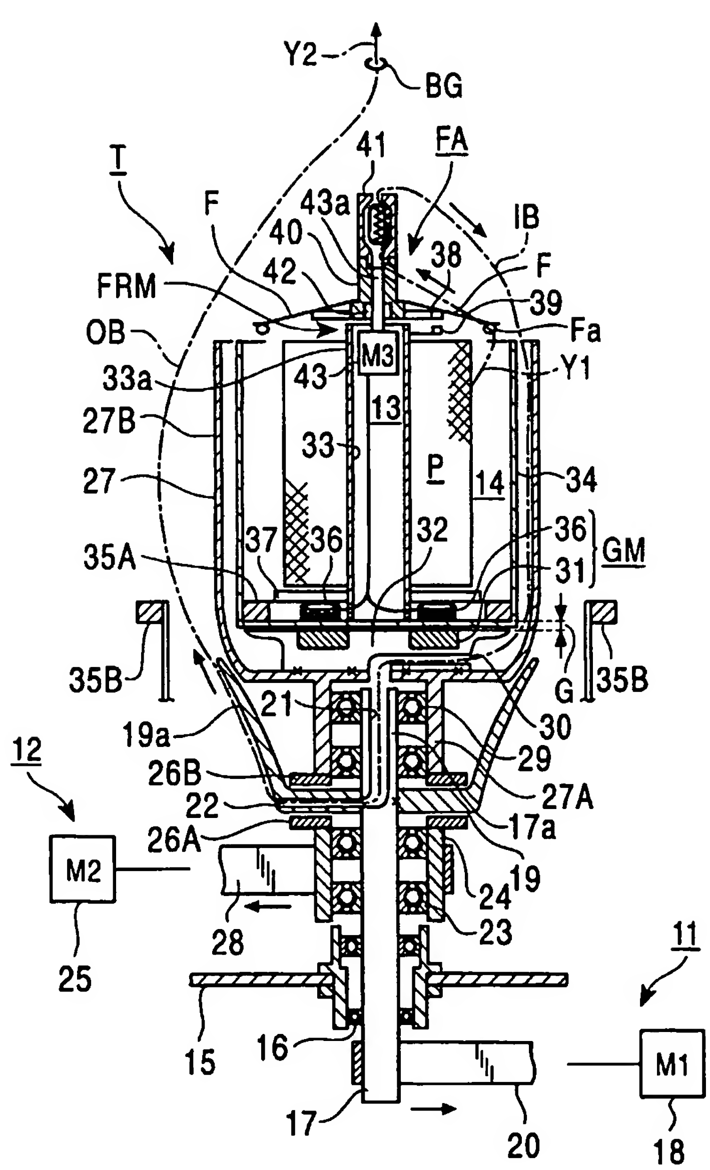


FIG. 1B

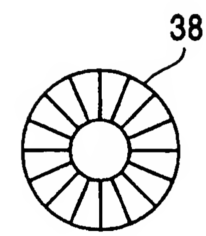


FIG. 1C

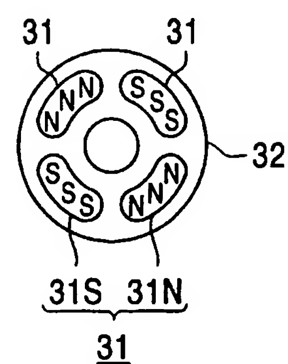


FIG. 2A

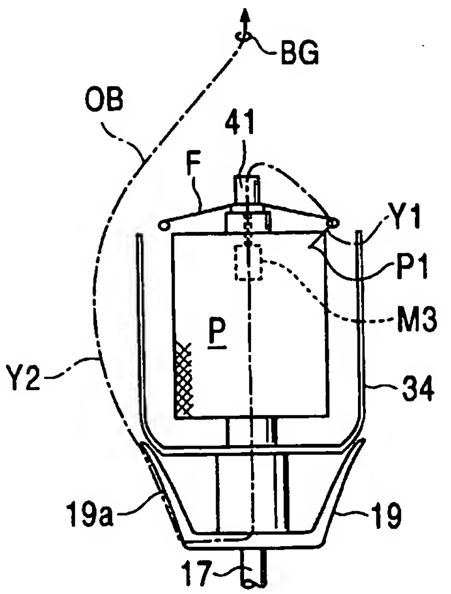


FIG. 2B

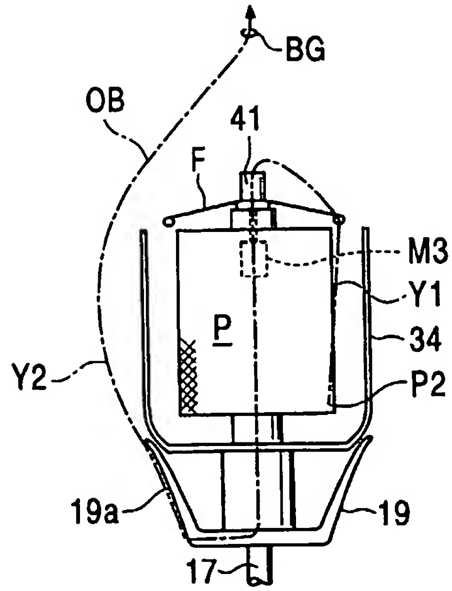


FIG. 3A

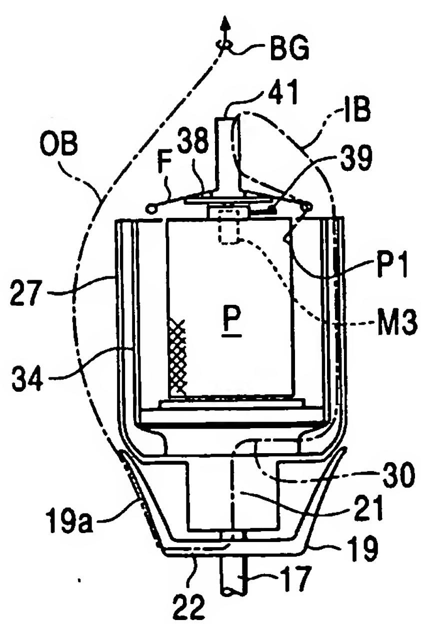


FIG. 3B

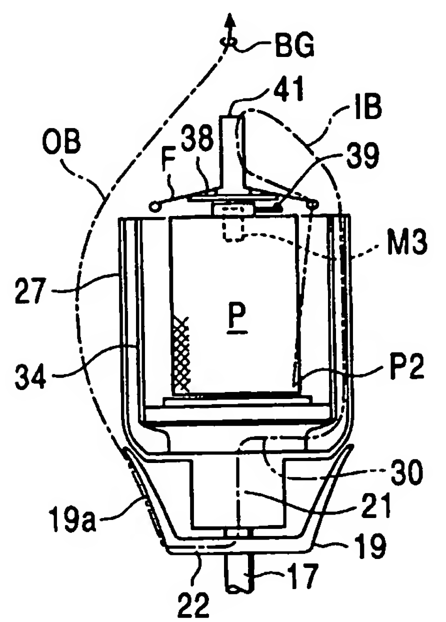


FIG. 4A

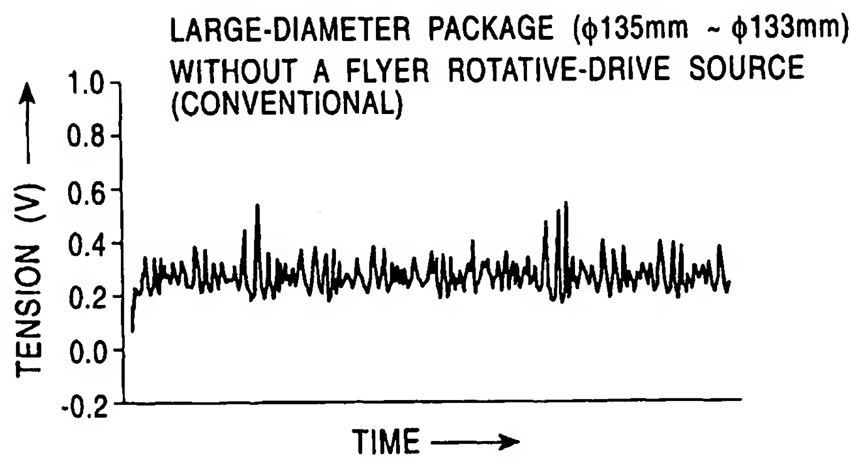

LARGE-DIAMETER PACKAGE (ϕ135mm ~ ϕ133mm)
WITHOUT A FLYER ROTATIVE-DRIVE SOURCE
(CONVENTIONAL)
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
TENSION (V)
TIME

FIG. 4B

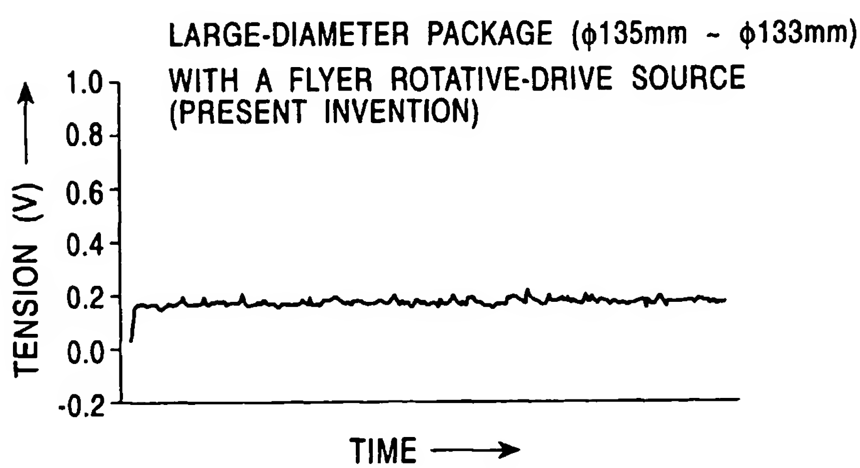

LARGE-DIAMETER PACKAGE (ϕ135mm ~ ϕ133mm)
WITH A FLYER ROTATIVE-DRIVE SOURCE
(PRESENT INVENTION)
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
TENSION (V)
TIME

FIG. 5A

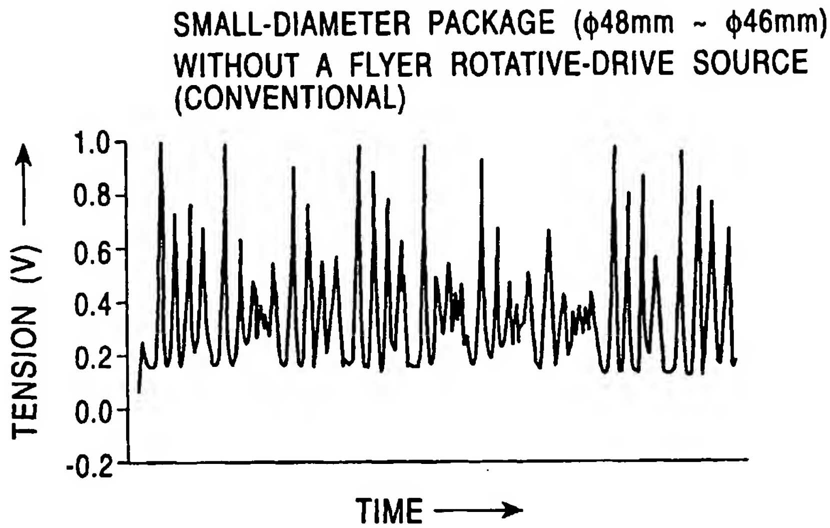

SMALL-DIAMETER PACKAGE (φ48mm ~ φ46mm)
WITHOUT A FLYER ROTATIVE-DRIVE SOURCE
(CONVENTIONAL)
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
TENSION (V)
TIME

FIG. 5B

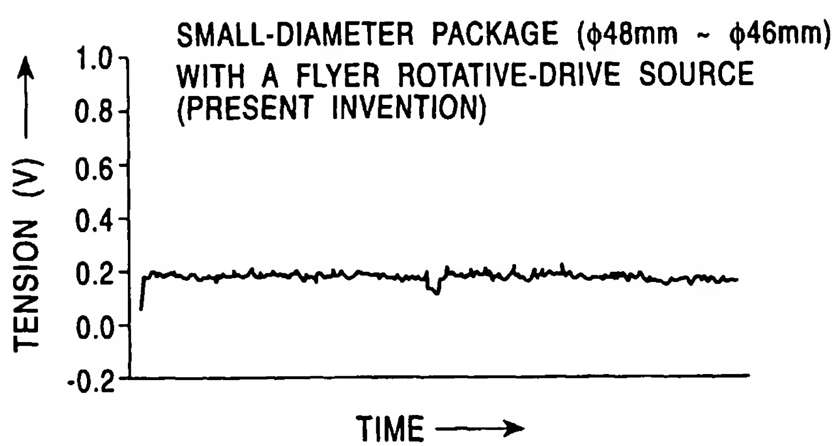

SMALL-DIAMETER PACKAGE (φ48mm ~ φ46mm)
WITH A FLYER ROTATIVE-DRIVE SOURCE
(PRESENT INVENTION)
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
TENSION (V)
TIME

FIG. 6

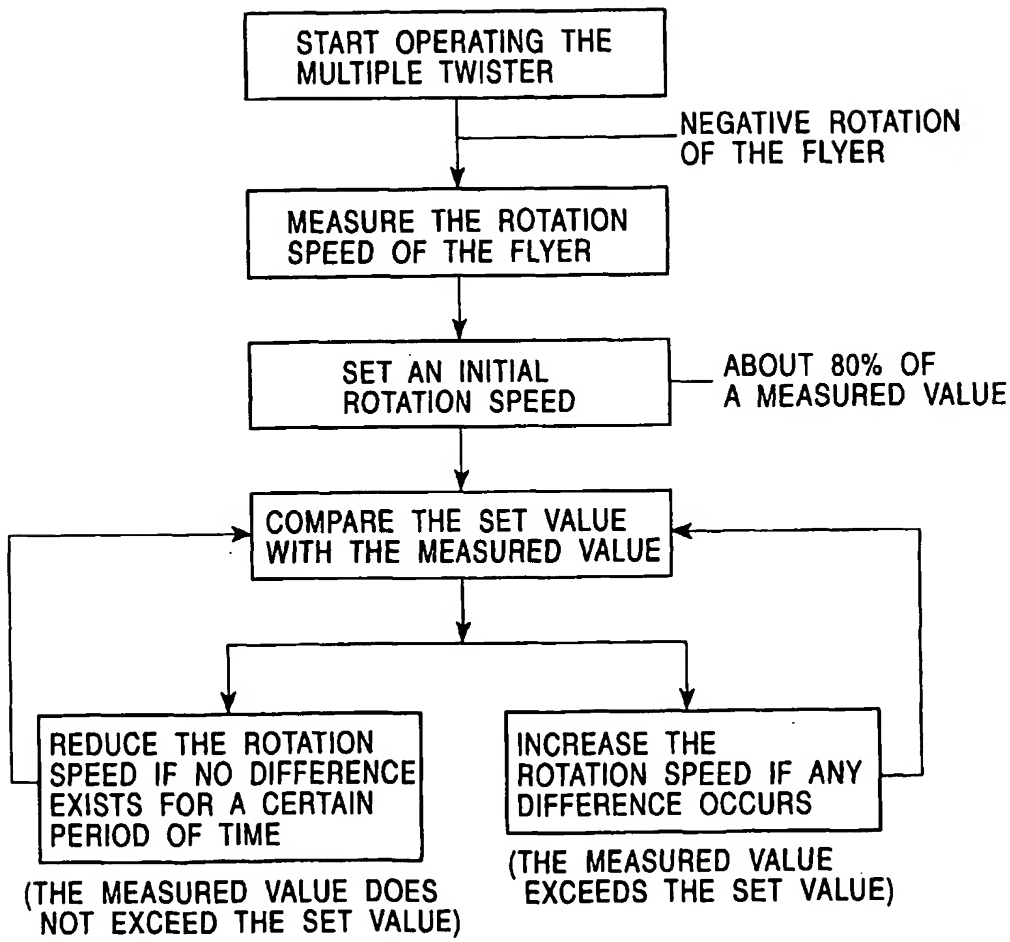
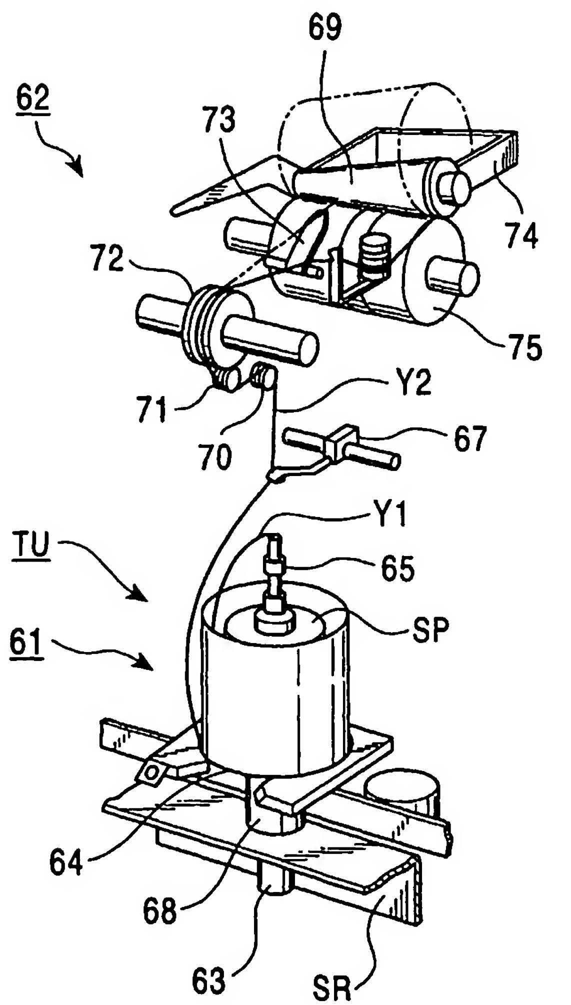

START OPERATING THE MULTIPLE TWISTER
NEGATIVE ROTATION OF THE FLYER
MEASURE THE ROTATION SPEED OF THE FLYER
SET AN INITIAL ROTATION SPEED
ABOUT 80% OF A MEASURED VALUE
COMPARE THE SET VALUE WITH THE MEASURED VALUE
REDUCE THE ROTATION SPEED IF NO DIFFERENCE EXISTS FOR A CERTAIN PERIOD OF TIME
(THE MEASURED VALUE DOES NOT EXCEED THE SET VALUE)
INCREASE THE ROTATION SPEED IF ANY DIFFERENCE OCCURS
(THE MEASURED VALUE EXCEEDS THE SET VALUE)

FIG. 7



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 00 10 2716

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
X A	US 4 687 151 A (ROSER ERICH ET AL) 18 August 1987 (1987-08-18) * column 6, line 8 - line 62; figures 1-6 *	1 2-11	D01H7/86 D01H13/10 B65H59/06
A	DE 94 11 246 U (SAURER ALLMA GMBH) 16 November 1995 (1995-11-16) * page 6, line 22 - page 8, line 11 * * page 9, line 10 - line 12; figures 1-3 *	1-11	
A	DE 19 24 003 A (PALITEX PROJECT-COMPANY GMBH) 12 November 1970 (1970-11-12) * page 7, line 9 - page 8, line 4; figures 1-4 *	1-11	
A	GB 1 108 456 A (PALITEX PROJECT-COMPANY GMBH) 3 April 1968 (1968-04-03) * column 3, line 5 - line 30; figures 1-7 *	1-11	

TECHNICAL FIELDS SEARCHED (Int.Cl.7)

D01H
B65H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	26 July 2000	Henningsen, O

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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& : member of the same patent family, corresponding document

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The members are as contained in the European Patent Office EDP file on
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26-07-2000

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